

EASTERN COYOTE *CANIS LATRANS* PREDATION ON ADULT AND PRE-FLEDGLING NORTHERN GANNETS *MORUS BASSANUS* NESTING ON MAINLAND CLIFFS AT CAPE ST. MARY'S, NEWFOUNDLAND, CANADA

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ABSTRACT

MONTEVECCHI, W., POWER, K., WHITE, E., MOONEY, C., GUZZWELL, L., LAMARRE, J., AEBERHARD, M. & FIELY, J. 2019. Eastern coyote *Canis latrans* predation on adult and pre-fledgling Northern Gannets *Morus bassanus* nesting on mainland cliffs at Cape St. Mary's, Newfoundland, Canada. *Marine Ornithology* 47: 39–42.

We document the first evidence of predation by invasive eastern coyotes *Canis latrans* on breeding seabirds on the island of Newfoundland, Canada. We detail kills of 110 Northern Gannets *Morus bassanus* (50 adults, 60 large pre-fledgling chicks) nesting on mainland cliffs at the Cape St. Mary's Ecological Reserve. During nocturnal predation, late in the Northern Gannets' nesting season (September/October), coyotes killed 68 birds (30 adults, 38 large pre-fledgling chicks) in 2016 and 42 birds (20 adults, 22 pre-fledgling chicks) in 2018. Most birds were killed by bites to the head and cranial punctures. Approximately one-quarter of the birds were partially (pectoral muscle) or fully consumed. Based on carcass condition, it appeared that coyotes killed, consumed, and left intact gannets for one week or longer. Although coyotes are not a significant threat to seabirds, they could increase selection pressure on seabirds nesting at mainland sites. Coyote-seabird interactions are likely to increase as the canids venture to coastal seabird nesting areas and islands.

Key words: coyotes, Northern Gannets, seabirds nesting on mainland, predation, invasive species, natural selection, Newfoundland

INTRODUCTION

Nesting on islands and cliffs is a common antipredator strategy adopted by colonial seabirds (e.g., Tuck 1961). Colonies are usually inaccessible to mammalian predators and are in proximity to marine food sources (Wittenberger & Hunt 1985). Isolation from terrestrial predators permits ground-nesters to lay their eggs and raise their chicks in the open without the use of intricate nests or cover (Nisbet *et al.* 2017).

At times, canid predators gain access to a breeding colony and prey on eggs, nestlings, and adult birds (e.g. Kruuk 1972, Maccarone & Montevecchi 1981, Bailey 1993). Depending on geographic location, red foxes *Vulpes vulpes* and arctic foxes *Alopex lagopus* are the most common canid predators that access seabird colonies (e.g., Lavers *et al.* 2009, Burke *et al.* 2011, Berteau *et al.* 2017).

The eastern coyote *Canis latrans* has recently appeared in seabird colonies in eastern North America (MacKinnon & Kennedy 2014). The species expanded its range to the island of Newfoundland, Canada in 1985, presumably moving to the island on sea ice during winter from Nova Scotia (Blake 1986).

At Cape St. Mary's, Newfoundland—the site of the Northern Gannets' *Morus bassanus* southernmost colony—the gannets nest on a large sea stack adjacent to the mainland. Owing to colony growth and crowding on the stack in the early 1980s, gannets began nesting on mainland areas immediately east and west of the stack (Montevecchi & Wells 1984). Since then, the mainland and overall breeding population at Cape St. Mary's has increased substantially

(Chardine *et al.* 2013), and aerial photographic analysis indicates that 50 % of breeders nest on mainland cliffs (S. Wilhelm unpubl. data). Coyotes have been visiting Cape St. Mary's since 2010, attracted by free ranging sheep in and around the reserve.

Although mainland-nesting gannets have been mostly undisturbed by foxes, the occurrence of coyotes could exert greater predator risk. The current study documents recent occurrences of, and predation by coyotes, on Northern Gannets at Cape St. Mary's, and speculates about coyote-seabird interactions in the future.

METHODS

Study area

The Cape St. Mary's Ecological Reserve (46°50'N, 61°09'W) is located at the southwestern tip of the Avalon Peninsula in eastern Newfoundland, Canada. The breeding population comprises approximately 15 000 pairs (Chardine *et al.* 2013). Most of the colony is distributed on a sea stack, Bird Rock, which is detached from the mainland by tens of meters but also by a hundred-meter deep ravine (Nettleship 1976). Following colony expansion in the early 1980s (Montevecchi & Wells 1984), the population of gannets nesting on the mainland has grown significantly (Chardine *et al.* 2013).

Observations and data collection

During long-term studies of the behavior and breeding success of Northern Gannets at Cape St. Mary's, we observed the behavior of birds nesting on the Bird Rock stack and on mainland sites.

Here, we report on observations of coyote predation on adults and large pre-fledgling chicks nesting on the mainland cliffs during late September/early October 2016 and during mid-September 2018. In 2016, all carcasses were photographed, and photographs were examined to determine which carcasses were partially eaten, fully eaten, or intact. In 2018, we made the same determinations by directly examining the carcasses and remains in the field, and we also assessed a subset of carcasses to determine cause of death (head/cranial puncture, neck bite, broken neck, chest bite).

RESULTS

In late September 2016, three dead adult gannets were seen above the mainland nest sites. A thorough search of the area on 06 October revealed a large kill of gannets at mainland nesting areas to the east and west of Bird Rock. The carcasses were scattered over the grassy plateaus above three mainland nesting sites (Fig. 1). The body count totaled 68 dead gannets: 30 adults and 38 large pre-fledgling chicks.

On 16 September 2018, gannet carcasses were again observed above the eastern mainland nesting site where gannets were killed in 2016; carcasses were also observed immediately to the west of the 2016 western carcass recovery site (Fig. 1). Body count and condition assessments revealed a total kill of 42 gannets, including 20 adults and 22 large pre-fledgling chicks. The recorded kills in 2016 and 2018 totaled 110 birds, including 50 adults and 60 large pre-fledgling chicks (Table 1).

Most birds were killed by bites to the head and cranial punctures (19 of 31 carcasses checked), with no differences between adults (63 %, 12 of 19) and chicks (58 %, 7 of 12; $\chi^2 = \text{NS}$; Fig. 2). Seventy-four percent (56 of 76) of the carcasses checked were intact, 11 % (8 of 76) were partially consumed (mostly pectoral muscle), and 16 % (12 of 76) were completely eaten except for wings and skeletal remains (Fig. 3). Thirty-three percent (15 of 46) of chicks were partially or entirely consumed, compared to 17 % (5 of 30) of adults ($\chi^2 = \text{NS}$). Variation in the freshness and deterioration of carcasses and remains indicated that coyotes likely preyed on gannets for one week or more. Although many carcasses were eaten on-site, it is not known if any were removed by the predators.

In 2016, carcasses were scattered at sites on plateaus above the mainland nesting sites. In 2018, at the main kill site (western

[W]) where 31 of 40 carcasses were located, most carcasses were aggregated below the plateau in a sloping central gully above the nesting site (Fig. 4).

Only a few gannets abandoned their nests in the predation sites. However, long-term nest abandonment was not observed, as new immigrants replaced birds that had been killed. It is not known how many coyotes were involved in the kills. One and possibly two coyotes were seen close to the colony on 17 September 2018.

On 26 May 2017, a red fox was seen in the mainland nesting area to the east of Bird Rock. In 2018, a red fox (possibly the same one) reared a litter of five kits in the reserve and kept them well-provisioned with murrens *Uria aalge* and at least one adult gannet and Razorbill *Alca torda*. Foxes were seen after the coyote incursion in 2018.

DISCUSSION

To our knowledge, there is no prior documentation of coyote predation on seabirds on the island of Newfoundland. In recent

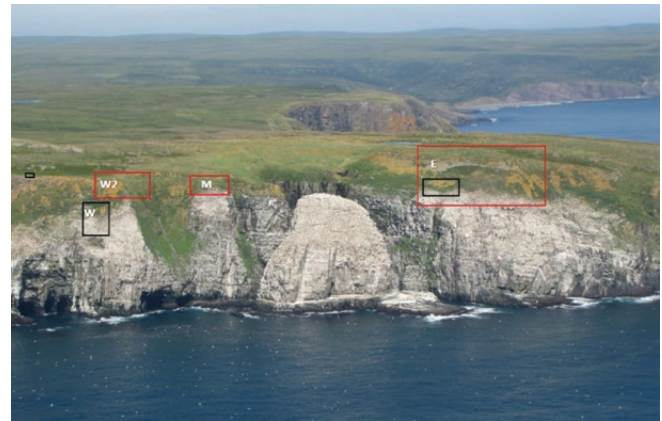


Fig. 1. Areas above mainland nesting sites in the Cape St. Mary's Ecological Reserve to the east and west of Bird Rock where Northern Gannet carcasses were found in 2016 (red rectangles) and in 2018 (black rectangles). From left to right: sites = western (W), western 2 (W2), middle (M), eastern (E); a few carcasses were found in the small site on the far left (photo: Tony Power).

TABLE 1
The age classes of Northern Gannets killed above mainland nesting sites at Cape St. Mary's, Newfoundland, Canada during September/October 2016 and 2018^a

Age Class	Western	Western 2	Middle	Eastern	Total
Adult 2016	0	18	4	8	30
Chicks 2016	0	3	10	25	38
Totals 2016	0	21	14	33	68
Adults 2018	19	0	0	1	20
Chicks 2018	14	0	0	8	22
Totals 2018	31	0	0	9	40
Total Adults 2016 + 2018	19	18	4	9	50
Total Chicks 2016 + 2018	31	3	10	33	60
Total Birds 2016 + 2018	33	21	14	42	110

^a see Figure 1

years, likely owing to range expansion, coyotes have been observed in seabird colonies in Nova Scotia (MacKinnon & Kennedy 2014), Massachusetts (Herland *et al.* 2016), and Mexico (Blinick *et al.* 2013). As at Cape St. Mary's and elsewhere, when predation occurred coyotes killed large numbers of birds. Many of the birds killed at Cape St. Mary's were not eaten, consistent with the canid pattern of overkilling and caching abundant prey (Andelt *et al.* 1980, Sklepkovych & Montevecchi 1996, Short *et al.* 2002).

The gannet nesting population at Cape St. Mary's was not significantly affected by the coyote predation. The gannets continued nesting in areas of heavy predation during subsequent breeding seasons, and there were no signs of abandonment (cf. MacKinnon & Kennedy 2014). Although the gannet population has been increasing (Chardine *et al.* 2013; S. Wilhelm unpubl. data), breeding success has been 50 % or lower since 2011 (LG, S. Wilhelm & WM unpubl. data). This suboptimal reproduction (Rail *et*

al. 2013) is attributed to transient ocean climate-induced decreases in fish availability (Montevecchi *et al.* 2013, Franci *et al.* 2015). Therefore, the combined influences of reduced food availability, oil pollution-related mortality (Montevecchi *et al.* 2011), and increased predation pressure and disturbance could further influence breeding success and population dynamics. Increased selection is expected against birds nesting on mainland areas accessible to mammalian predators. Given that half of the gannet colony nests on mainland cliffs, future risks could potentially be substantial.

For a century or longer, sheep have grazed around Cape St. Mary's, but in 2010 coyotes began killing them. The flocks of sheep and lambs likely attracted coyotes to the area. Owing to high predation rates on their livestock, owners stopped releasing sheep in the reserve in 2017. Although no coyotes were known to visit the reserve in 2017, coyotes returned to prey on gannets in 2018.

In September and October 2015, two coyotes were shot just outside the reserve. The coyote shot in October had remains of gannet eggs in its stomach; given the time of year, the eggs would either have been added abandoned eggs or eggs that had been cached earlier in the year. During winter 2016/17, more coyotes were shot in the nearby area, but none are known to have been shot during winter 2017/18.

Coyotes have been observed at other seabird colonies in Newfoundland. For example, in August and early September 2018, a coyote was reported and fresh tracks were seen on South Penguin Island off the northeast Newfoundland coast (J. Chaulk & J. Montevecchi pers. comm.). Presumably, the coyote reached the island by crossing on winter sea ice. Ground-nesting marine birds on South Penguin Island include Common Eiders *Somateria mollissima*, Leach's Storm-Petrels *Oceanodroma leucorhoa*, Herring Gulls *Larus argentatus*, Great Black-backed Gulls *Larus marinus*, terns *Sterna* spp., and Atlantic Puffins *Fratercula arctica* (Cairns *et al.* 1984). However, no signs of predation were observed.

Foxes are common at Cape St. Mary's, and observations of silver and cross foxes are indicative of escapes from nearby fur farms. A red fox was seen near the colony on 19 September 2018; there was no evidence of further predation by coyotes thereafter. On Bonaventure Island (Quebec), red foxes were observed scaring gannets from roosting and peripheral nesting areas. This disturbance



Fig. 2. Adult Northern Gannet carcass with cranial puncture (photo: Jonathan Fiely).



Fig. 3. Left: pre-fledgling Northern Gannet with pectoral muscle eaten; Right: adult Northern Gannet entirely consumed except for wings and skeletal remains (photos: Kyran Power).



Fig. 4. Northern Gannet carcasses aggregated by eastern coyotes above nesting cliffs (photo: Bill Montevecchi).

induced the birds to regurgitate food, which was subsequently eaten by the foxes.

CONCLUSION

Invasive coyotes are currently not considered a major threat to seabirds on the island of Newfoundland, or elsewhere. In Newfoundland, coyotes might be reoccupying part of the niche of the extinct Newfoundland wolf *Canis lupus beothucus*. We anticipate more coyote predation on seabirds as coyotes venture to coastal nesting areas and islands. Continued monitoring of the nesting of Northern Gannets at Cape St. Mary's will provide a better understanding of the physical and biological factors that influence their nesting habitat, breeding success, and population dynamics. If coyote predation and disturbance continue, this will induce negative selection on the gannets nesting on the mainland areas of the reserve.

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